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THE QUESTION OF THE INFLUENCE OF A PERMANENT MAGNETIC FIELD ON WATER

by

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In technical journals over the past ten years a great many works have appeared which have been devoted to the influence of the so-called "magnetization" of feed water against the formation of scale on boiler walls. This article explains the possibility of the effect of a uniform, permanent magnetic field on the structural properties of rest water and its solutions under strictly monitored conditions. As the control measurements we carried out a series of experiments with freshly-produced bidistilled and distilled water with pH's of 6.8 and 6.3, respectively, at temperatures T = 283 and 293°K and magnetic field strengths of 1000 and 2000 Oe. The experiment results were processed statistically. Data show that with an accuracy of ±2% with a confidence level of 95% a permanent uniform magnetic field with strengths of 1000 and 2000 Oe does not change the properties of pure water at temperatures T = 283 and T = 293°K.

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THE QUESTION OF THE INFLUENCE OF A PERMANENT MAGNETIC FIELD ON WATER

V. B. Yevdokimov and V. A. Zubarev

In technical journals over the past ten years a great many works have appeared which have been devoted to the influence of the so-called "magnetization" of feed water against the formation of scale on boiler walls [1]. In a brief report it is impossible to give a complete analysis of the works; however, we should point out their insufficiently high level of methodology. In this regard, at the present time many researchers are attempting to detect, in water and its solutions subjected to magnetic processing, changes in the physical and physicochemical indices [2-5].

The purpose of our work was to explain the possibility of the effect of a *uniform, permanent* magnetic field on the structural properties of pure water and its solutions under strictly monitored conditions, for which we determined the viscosity of the water by the method of the average bilateral time of first passage (the [illegible] method) [6]. The essence of this method, developed by [illegible] and Smoluchowskiy [7], is to estimate the behavior of Brownian particles in a liquid. As the Brownian particles [illegible] used diamagnetic carbon particles with radius of the order [illegible] μ, in a concentration [illegible] that they are, on the average, 10-15 μ apart. The [illegible] of the liquid in the [illegible] prepa-

ration was about 100μ. We estimated the change in number n which shows how often, in time t, a particle of radius r covers a given distance l in a magnetic field (n) or without it (n_0). From forms $\eta = \frac{RT}{N}\frac{t}{3\pi r l^2 n}$, where R is the gas constant, N is the Avogadro number, T is absolute temperature and η is the coefficient of viscosity, we see that $\frac{\eta_H}{\eta} = \frac{n}{n_H}$, i.e., from the change in n with the other parameters remaining constant we can judge as to structural changes in the liquid. The measured preparation was thermostatted with an accuracy of ±0.05°, which could lead to variations of ±0.2% in the viscosity index. The uniform permanent magnetic field was established and maintained with an accuracy of ±2%. In time t = 15 ± 0.1 min we simultaneously measured values of n for two mutually perpendicular directions n along and across the field force lines ($n_\parallel$ and $n_\perp$).

$n_\parallel$	f	a, M=23	fa	fa^2
20	1	−3	−3	9
21	2	−2	−4	8
22	4	−1	−4	4
23	6	0	0	0
24	5	+1	5	5
25	2	+2	4	8
26	0	+3	0	0
Σ	20		−2	34

$n_\perp$	f	a, M=23	fa	fa^2
20	1	−3	−3	9
21	1	−2	−2	4
22	5	−1	−5	5
23	6	0	0	0
24	4	+1	4	4
25	2	+2	4	8
26	1	+3	3	9
Σ	20		+1	39

As the control measurements we carried out a series of experiments with freshly-produced bidistilled and distilled water with pH's of 6.8 and 6.3, respectively, at temperatures T = 283 and 293°K and magnetic field strengths of 1000 and 2000 Oe. The experiment results were processed statistically. As an example, let us present the analysis of data obtained for bidistilled water with pH = 6.8 at T = 293°K in a magnetic field with H = = 2000 Oe. The total observation time was 5 hours with 5 preparations:

$$\sigma_\parallel = \pm\sqrt{\frac{\Sigma f\varepsilon^2}{K-1}} = \pm 1{,}4, \quad \sigma_\perp = \pm 1{,}43; \quad \sigma_{A\perp} = \pm 0{,}3,$$

$$\sigma_{A\parallel} = \frac{\sigma_\parallel}{\sqrt{K}} = \pm 0{,}3, \quad A_\perp = 23{,}05 \pm 0{,}3(\pm 1{,}3\%),$$

$$A_\parallel = M + \frac{\Sigma f\varepsilon}{\Sigma f} = 22{,}9 \pm 0{,}3(\pm 1{,}3\%), \quad A_{cp} = 23{,}0 \pm 0{,}2(\pm 1{,}0\%).$$

Here we have used the following arbitrary designations: f - frequency of appearance of a given value of n; ε - central deviation, the difference between the date and the condition of the arithmetic mean M; A - arithmetic mean, with subscript (cp.) (mean) = ($A_\parallel + A_\perp$):2; $\sigma_\parallel$ and $\sigma_\perp$ are, respectively, the quadratic deviations of $n_\parallel$ and $n_\perp$ individually; σ_A is the standard error in the arithmetic mean A; K is the sum of f.

In experiments with bidistilled and distilled water, carried out under the same conditions but without a field (H = 0), with 8 preparations with a total observation time of 8 hours we obtained the following values: $\sigma_\parallel = \pm 1.5$ $\sigma_{A\parallel} = \pm 0.3$, $A_\parallel = 23.0 \pm 0.3(\pm 1.3\%)$, $\sigma_\perp = \pm 1.4$ $\sigma_{A\perp} = \pm 0.3$, $A_\perp = 23.1 \pm 0.3(\pm 1.3\%)$, $A_{cp} = 23.1 \pm 0.2(\pm 1.0\%)$

With H = 2000 Oe and T = 293°K, using three preparations with the bidistillate for a total of 5 hours we obtained the values: $A_\parallel = 17.0 \pm 0.2(\pm 1.2\%)$; $A_\perp = 17.2 \pm 0.2$; $A_{cp} = 17.1 \pm 0.14(\pm 1.0\%)$. With H = 1000 Oe and T = 283°K and 293°K the values of $A_\parallel$, $A_\perp$ and A_{cp}, obtained during a total observation time of 10 hours, do not differ from the corresponding values obtained for H = 2000 Oe for the same temperatures times the value of the standard error. Thus, these data show that with an accuracy of ±2% with a confidence level of 95% a permanent uniform magnetic field with strengths of 1000 and 2000 Oe does not change the properties of pure water at temperatures T = 283 and T = 293°K.

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